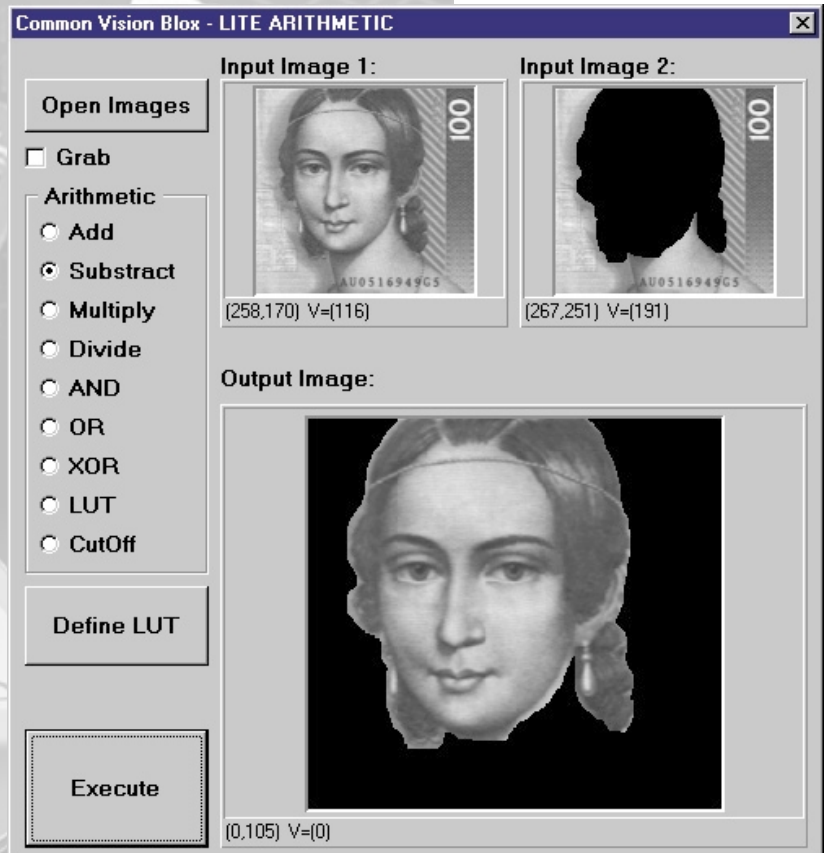
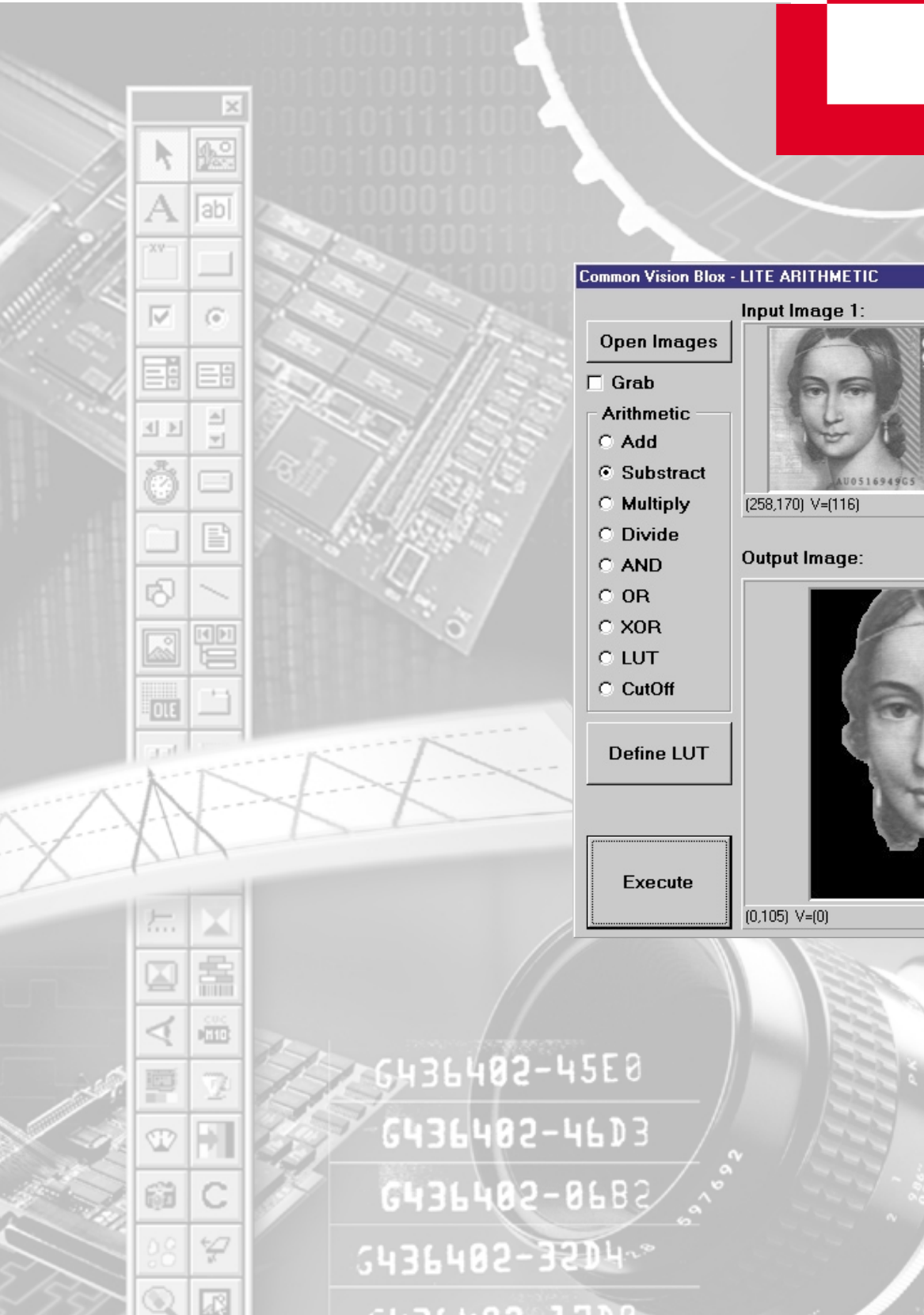
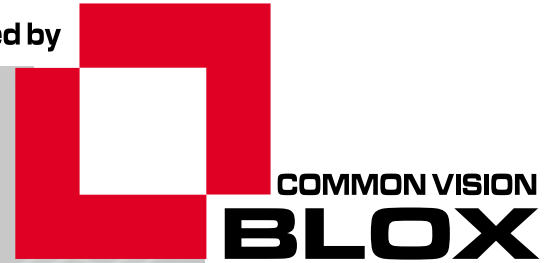


# ► Arithmetic

powered by



Software tool  
for image combination

# ► Arithmetic

The software tool Arithmetic is a function library which can be used to combine Common Vision Blox compatible images. This makes it possible, for example, to add, subtract, multiply and divide two images pixel by pixel. Any range overflows that occur can be handled in a flexible manner. For example, adding two 8-bit images may result in an 8-bit image or an 16-bit image.

The arithmetical or logical combination of images is a great help when masking or calibrating images. This function allows you, for example, to eliminate disturbing artifacts in the image background by subtraction or to block out unwanted parts of an image using a mask. Furthermore, differences between images can be revealed by means of image subtraction. These examples serve to indicate the wide range of possible applications in both industry and medicine (such as digital subtraction angiography).

## ► Image combination functions

Arithmetic provides functions that can be used on one channel of an 8-bit or 16-bit image to create a new image which also has a bit depth of either 8 or 16 bits. Besides the addition, subtraction, multiplication, division, AND-ing, OR-ing and XOR-ing of two input images it is also possible to combine two images on the basis of a user-defined 256\*256 LUT (lookup table). The library also contains functions which allow the user to reduce the bit depth of the input image or to transform it using a LUT.

In order to ensure the highest possible level of flexibility, several different methods of image access are supported: Methods for fast linear image access are implemented for image sources that allocate linear memory for each plane (e.g. monochrome cameras). For image sources that use non-linear memory (e.g. multi-tap cameras) methods are provided for image access using a VPAT (Virtual Pixel Access Table). The use of MMX technology gives Arithmetic a significant speed advantage over conventional methods.

### Functions of Arithmetic:

- Addition, subtraction, logical operations (AND, OR, XOR)
- Multiplication, division
- Reduction of the bit depth of the image from 16 to 8 bits
- LUT transformation

The functions of Arithmetic are made available in the form of a DLL. This provides the highest level of flexibility for embedding the functions in your own applications. The DLL can be used in Microsoft's Visual Basic and Visual C++ environments and in Borland Delphi.

### Image calibration with CVB Arithmetic

Despite every effort to select the appropriate lighting, lens and camera, some inhomogeneities of the overall acquisition system can persist. These are caused by local variance in the sensitivity of the sensor, uneven lighting, vignetting of the lens or other artifacts.



The image calibration function can be helpful when trying to get eradicate such inhomogeneities which render image evaluation more difficult. Inhomogeneities are reduced with the help of a calibration image that has to be acquired »without an object« against a homogeneous background. In an ideal situation this image only contains the systematic inhomogeneities of the acquisition system itself.



Calibration of the output image is performed by dividing the uncalibrated image by the calibration image and multiplying the result with a constant factor to enhance the gray value range:

$$I_{\text{Out-Kal}} = \left( \frac{I_{\text{Out}}}{I_{\text{Kal}}} \right) \cdot I_{\text{Soll}}$$

The resulting image is then free of systematic inhomogeneities. Of course, statistical fluctuations (e.g. noise) cannot be corrected using this method of image calibration.

